UTILIZATION OF ARTIFICIAL INTELLIGENCE ALGORITHMS IN THE PERIOPERATIVE MANAGEMENT AND REDUCTION OF PAIN: AN EVIDENCE-BASED EDUCATIONAL MODULE

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BACKGROUND

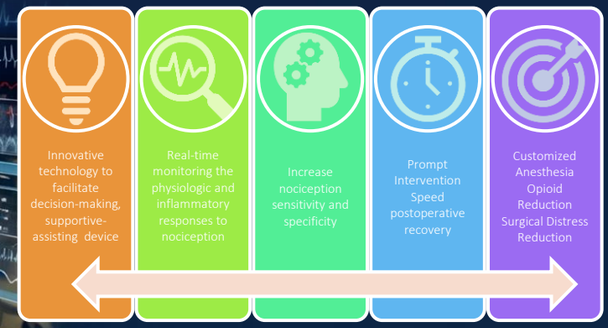
PICO

In anesthetized adult patients undergoing surgical procedures requiring intraoperative pain management, how does the use of AI-powered algorithms for Nociception Level (NOL) compare to Analgesia Nociception Index (ANI) model systems for the reduction of perioperative physiologic pain, minimization of opioid underdosing or overdosing, expedient postoperative recovery, and enhanced overall patient outcomes?

RECOMMENDATIONS

ANI and NOL are promising tools for monitoring nociception during general anesthesia, with evidence supporting their sensitivity, discriminative ability, and predictive power. However, further research is required to establish the long-term implications of AI-powered algorithms.

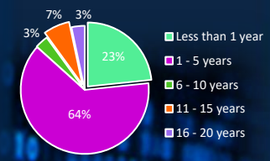
RESULTS



Sample predominantly male demographic (56.7%) aged 25-54, with 64.0% having < 5 years of experience, youthful workforce tends to be receptiveness to emerging technologies.

No significant difference between pre- and post-survey, 92.3% stated AI as a additional tool alongside clinical expertise, indicates collaboration over replacement.

Anesthesia Workforce Experience



Pre- 55% viewed AI-assisted approach positively, rising to 84.7% post-survey, 15.4% remained unsure vs 35% undecided pre- indicating widespread recognition of AI's role in optimizing pain management. Post-education, confidence in AI's positive impact soared to 92.6%, underlining the efficacy of targeted educational initiatives.

The Pre- and Post result most claimed benefits were customized pain management (70% vs 92.3%) and patient safety (60% vs 53.8%) , 30.8% cost-effectiveness. Most point out challenges were resistance to change (75% vs 76.7%) and technical complexity (65% vs 76.9%).

Significant differences across age groups indicate need for tailored educational strategies. Newer providers were more optimistic about AI's benefits than experienced ones, underlining the importance of ongoing professional development.

CLINICAL SIGNIFICANCE

- ✓ Potential advantages & disadvantages
- ✓ Educational Impact
- ✓ Patient Advocacy
- ✓ Ethical Considerations
- ✓ Interdisciplinary Collaboration

PROJECT PURPOSE

- Literature review
- Educational module initiative
- Results dissemination
- Encourage further research

LEARNING OUTCOMES

- Enhance professional awareness
- Discuss the relevance, benefits and challenges
- Promote ethical insights
- Encourage anesthesia advancement

RESEARCH OBJECTIVES

- Effect on physiological surgical distress
- Compare ANI vs NOL sensitivity & specificity
- Impact on opioid overdosing & underdosing
- Assess provider's current perception

METHODOLOGY

Realistic
SMART Objectives

Specific
Evaluate the effectiveness of AI-driven NOL and ANI algorithms in reducing the amount of opioid-administrated perioperative in response to surgical-induced physiologic pain distress

Achievable
Conduct a comprehensive review of existing research and clinical data on AI-driven solutions used in perioperative pain management within the last five years. Within the relevant objective, this article offers to assess the relevance of AI technology in the current healthcare system, where tailored patient care, opioid reduction, and improved clinical outcomes are essential goals.

Relevant
Assess the relevance of AI-powered technology in the current anesthesia clinical practice, where personalized patient care, opioid reduction, and improved clinical outcomes are becoming critical goals within the anesthesia practice.

Timebound
Completing the review and analysis of existing literature and data relevant to this project that can generate new knowledge or update insights related to AI-assisted perioperative pain management within a twelve-month timeframe.

Literature Review

Author	Design	Sample	Major Findings
Ma D, et al.	Meta-analysis of RCTs	21 RCTs Sample 1957	Intraoperative opioid administration was significantly lower in nociception monitor-guided analgesia vs SOC management (SMD, -0.71; 95% CI, -1.07 to -0.36; P < 0.001). ↓ extubation time (SMD, -0.22; 95% CI, -0.41 to -0.03; P = 0.02), and ↓ PONV (RR, 0.78; 95% CI, 0.61 to 1.00; P = 0.05)
Kim MK, et al.	Systematic Review, Meta-analysis	30 RCT Sample 516	Predicting intra-operative pain, sensitivity, specificity, diagnostic odds ratio (DOR), and area under curve of ANI were 0.81 (95% confidence interval [CI] = 0.79-0.83; I2 = 68.2%), 0.93 (95% CI = 0.92-0.93; I2 = 99.8%), 2.32 (95% CI = 1.33-3.30; I2 = 61.7%), and 0.77 (95% CI = 0.76-0.78; I2 = 87.4%), respectively. ANI values and hemodynamic changes intraoperative showed statistically significant correlations.
Balan C, et al.	Randomized Controlled Trial	RCT Sample 83	NOL index-assisted + bilateral single-shot ESPB benefits undergoing open heart surgery reduced the total intraoperative fentanyl and cumulative 48h morphine by 73.3% and 63.5%. Faster extubation, ↓vasopressor support, and better quality of analgesia up to 48 h after surgery.
Meijer FS, et al.	Randomized Controlled Trial	RCT Sample 80	28% reduction in remifentanil in NOL group vs. SOC group, (mean ± SD) 0.119 ± 0.033 to 0.086; P < 0.001). SOC group, had higher vasoactive use due to hypotensive events (MAP < 55mmHg) vs the NOL group; 2 of 40 (5%) vs 11 of 40 (28%) in the SOC group (relative risk, 0.271; 95% CI, 0.08–0.77; P = 0.006). Fewer NOL group showed bradycardia (HR < 45/min), faster recovery after NMB reversal, and speeding extubation vs SOC group.
Shahiri TS, et al.	Systematized Review	15 RCT Sample 586	ANI values increased in response to higher opioid dosage, w/ mean and median values at lower (SD=±16-17) vs higher (SD=±19) opioid concentration, significant upsurge after fentanyl bolus, Wilcoxon rank; p < 0.05 and RM-ANOVA p < 0.001. Predictive capability, Pk values of 0.38-0.98 related to ANI 0.90 vs 0.97 NOL index. ANI cut-off values sensitivity of 80-88% and specificity of 83-98% vs NOL 73-89% sensitivity and 80-92% specificity.
van der Wal I, et al.	SOLAR Study	**2 RCT Sample** 125	NOL-guided analgesia leads to improved postoperative pain management, reduced severe pain, and a decreased need for opioid medication in the PACU. 4.6 NOL group vs 6.2 SOC group, mean values with actual difference 1.7, p = 0.001, NOL-guided group 66% had pains scores < 4 in PACU stay. 33% opioid reduction NOL-guided analgesia vs 10% SOC (p = 0.002), ↑ patient satisfaction and potentially ↓risk of opioid-related complications.

LIMITATIONS

- ✗ Relative small sample size, from 202 surveyed only 30 were complete and used for the analysis results.
- ✗ Potential bias related to self-selection of survey
- ✗ Demographic homogeneity, only FIU Alumni CRNAs' providers were included in the sample.

REFERENCES